

Technical Data

Frame Grabber **Windows NT (Intel):** BitFlow RoadRunner and Raven, Cheops Ramses-1, Data Translation DT 315x, DBS DFG/LC1 and DFG/LC2, IDS FALCON and EAGLE, Imagenation PX510, PX610, and PXC 200, Integral FlashBus, Leutron PicPort, LinX GINGA, Matrox Meteor, MRT VideoPort Professional, Mikrotrotron Inspecta-2, general purpose TWAIN interface.

Windows NT (Alpha): BitFlow RoadRunner.

Linux (Intel): Matrox Meteor.

Solaris (Sparc): Data Cell Snapper24, Osprey SLIC-Video, Visicom VignaPix. Additional frame grabbers are easy to integrate.

File Format Tiff, BMP, Sun-Raster, GIF, PNM, PCX, XWD, binary.

Calibration Calibration of internal and external camera parameters from multiple images for pinhole and telecentric cameras; correction of radial distortions for images and points; determination of optical rays.

Blob Analysis **Threshold** Range, local, automatic.

Region processing Connected components, skeleton, junctions, end points, set operations (intersection, difference, union, complement), hulls (rectangle, circle, ellipse, convex) filling of holes, region generation (rectangle, circle, ellipse, polygon, grid, checker, random), access (runlength encoding, chain code, contour, polygons).

Gray value features Minimum, maximum, mean, deviation, co-occurrence, histogram, entropy, fuzzy features, gray moments.

Shape features Area, center, orientation, circularity, compactness, number of holes, contour length, convexity, elliptic axis, moments (2nd and 3rd), eccentricity, hamming distance, hulls (circle, rectangle), distance, spatial relations, Euler number.

Subpixel Edge & Line Extraction Canny, Deriche, Lanser, and Sobel edge detectors and Facet model and Steger line detectors with an accuracy of up to 1/50 pixel.

Edge Position Measurement Subpixel edge extraction along lines and circular arcs; automatic selection of edges (first, last, all, rising, falling, pairs).

Pattern Matching Gray value matching with arbitrary size, shape, and rotation; best match, all matches, multi grid match.

Optical Character Recognition (OCR) Character-based recognition, specialized segmentation, clustering of characters, rotation elimination, fonts trainable, selectable features.

Optical Character Verification (OCV) Gray value based pattern comparison; invariant with respect to illumination, position, and size changes.

Bar Code Reader Multiple 1D bar codes (EAN 13, EAN 8, 2/5 Industrial, 2/5 Interleaved, Code 39, Codabar).

Depth from Focus Estimation of the depth from a series of images taken at different distances.

Segmentation **Threshold** Color, hysteresis.

Regiongrowing Gradient, mean value, color, texture.

Classification n-dim., clusters: n-dim. boxes and spheres.

Miscellaneous Watersheds, difference checker, gray expansion.

Morphology **Binary** Minkowski-addition/subtraction, dilation, erosion, opening, closing, hit-or-miss, morphological sieve, morphological skeleton, skiz-operator, boundary, pruning, thickening, thinning.

Gray value Minimum, maximum, dilation, erosion, opening, closing, top hat, bottom hat.

Geometry **Affine transformations (different interpolation methods)** Rotation, scaling, translation, mirroring, cropping, polar transformation.

Line and point features Distances between points, lines, and regions, angles between lines, intersection of lines.

Filtering **Image enhancement** Contrast enhancement, illumination correction, scaling, histogram adaption, interlace error correction.

Smoothing Anisotropic diffusion, Gaussian smoothing, mean filter, rank filters (median, separate median, weighted median, etc.), midrange filter, sigma filter, trimmed mean, salt and pepper noise elimination, recursive smoothing filters.

Edge Filters Canny, Deriche, Lanser, Shen, Frei, Kirsch, Roberts, Prewitt, Robinson, Sobel, Laplace, diff-of-gauss, derivatives of Gaussians, Edge closing.

Point Filters Mean curvature, gauss curvature, eigenvalues, main curvatures, higher gauss derivatives, corner response, Kitchen & Rosenfeld, Zuniga & Haralick, De Saint Venant.

Texture Law's filters (3x3, 5x5, 7x7), deviation, entropy.

Arithmetics Scaling, addition, subtraction, multiplication, absolute value, maximum, minimum, inversion.

Bit operations Or, and, xor, shift, masking, complement, bit selection.

Color transformations CIElab, hsv, hsi, yiq, CIExyz, hls, ihs, isfeuklid, isfdiff.

Fourier convolution Gabor/Hilbert filter, bandpass, highpass, lowpass, energy, phase, power, Wiener filter, general Wiener filter, defocus, linear translation.

Hough transformation Lines, circles.

Miscellaneous convolutions Grayvalue matrix, gray skeleton, principal components, topographic sketch, Gauss pyramid, monotony operator, type conversion.

Image Sequences Background estimation, optical flow.

Tools **Kalman filters** Prediction of parameters or objects in an image sequence.

Shape from shading

Photogrammetric stereo

Debugging Flexible control of all HALCON operators including numerical and iconic parameters; control of all internal states like object database or heap memory.

Classification Clustering with n-dimensional boxes and spheres for nonnormal distributed data sets.

Sockets Exchange of images, regions, XLD, and control data between HALCON processes.

Serial Interface Reading and writing of data via the serial interface.